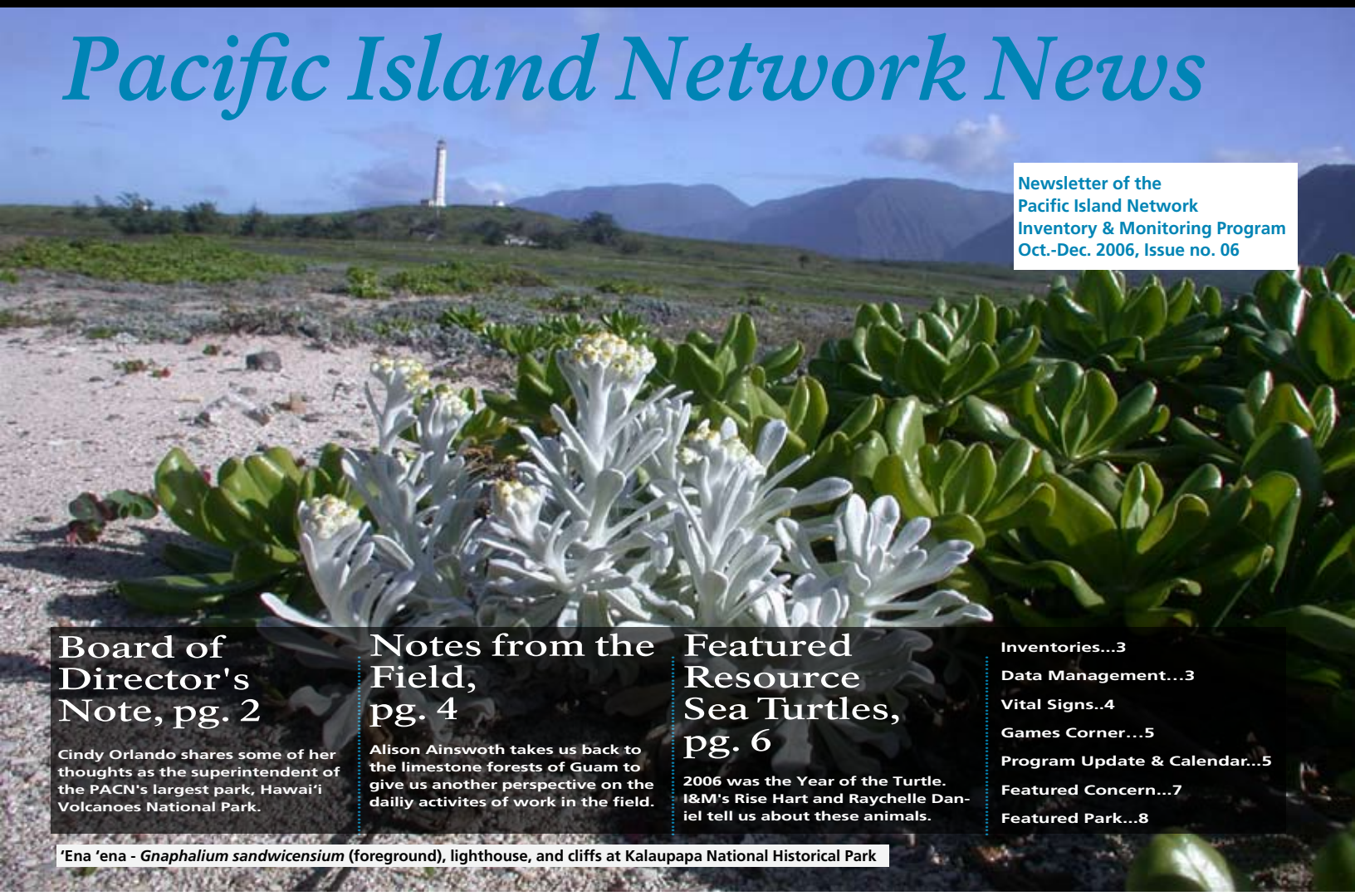
National Park Service
U.S. Department of the Interior

Pacific Island Network News

Newsletter of the
Pacific Island Network
Inventory & Monitoring Program
Oct.-Dec. 2006, Issue no. 06



'Ena 'ena - *Gnaphalium sandwicensium* (foreground), lighthouse, and cliffs at Kalaupapa National Historical Park

Aloha. Talofa. Hello. Tirow. Hafa adai.

The Pacific Island Network (PACN) consists of tropical islands and archipelagoes including national park units in Hawaii, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. Enjoy this edition of news briefs and stories about the National Park Service's (NPS) Pacific Island Network.

Pacific Island Network
NPS Inventory & Monitoring Program
Hawaii-Pacific Islands CESU

"E na'i wale nō 'oukou, I ku'u pono 'a'ole i pau"
(Strive to pursue my unfinished good deeds)
—Kamehameha 'Ekahi (first)

Pu'ukoholā Heiau National Historic Site

National Park Service
U.S. Department of the Interior

Pacific Island Network
P.O. Box 52
1 Crater Rim Drive - Qtrs 22
Hawai'i National Park, HI 96718

Hawaii-Pacific Islands Cooperative Ecosystem Studies Unit
University of Hawaii at Manoa
3190 Maile Way, St.John Hall #408
Honolulu, HI 96822-2279

The National Park Service has implemented natural resource inventory and monitoring on a servicewide basis to ensure all park units possess the resource information needed for effective, science-based management, decision-making, and resource protection.

Network Coordinator:
Leslie HaySmith 808-985-6180

Pacific Island Network Staff:
Sandy Margriter 808-985-6074
Fritz Klasner 808-985-6181
Gordon Dicus 808-985-6182
Allison Snyder 808-985-6186
Tahzay Jones 808-985-6188

Hawaii-Pacific Islands CESU Cooperators:
Karin Schlappa 808-985-6183
Heather Fraser 808-985-6183
Viet Doan 808-985-6184
Page Else 808-985-6184
Kelly Kozar 808-985-6184
Cory Nash 808-985-6185
Joan Yoshioka 808-985-6185
Gail Ackerman 808-985-6187
Rise Hart 684-633-7082 (NPSA)
Alison Ainsworth 808-967-7396 x266

NPS Ecologist and PWR Science Advisor:
Darcy Hu 808-985-6092

Comments? Write to:
Cory Nash, Editor
Pacific Island Network
P.O. Box 52
Hawai'i National Park, HI 96718
Phone: 808-985-6185
Fax: 808-985-6111
Email: corbett_nash@contractor.nps.gov
Web: http://science.nature.nps.gov/im/units/pacn/

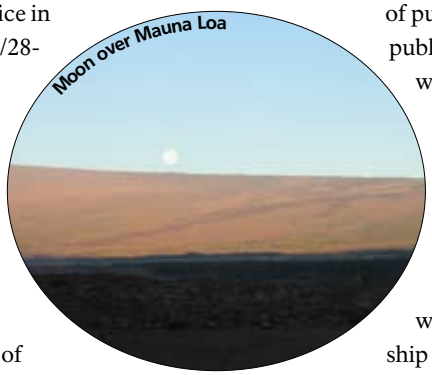
Mailing List:
Please pass this newsletter on to interested parties. To be added to or removed from mailing list, please contact Cory Nash.

***NOTE:** Unless indicated all photos and articles are NPS.
CONTRIBUTORS: C. Orlando, K. Schlappa, C. Nash, R. Daniel, R. Hart, B. Saldua, R. Boston, G. Ackerman, A. Ainsworth, A. Kaawaloa-Okita, M. Larson, K. Kozar, R. Camp, T. Pratt, A. Snyder, M. Hart, L. HaySmith, G. Dicus, J. Yoshioka

Board of Director's Note

Superintendent Cindy Orlando - Hawai'i Volcanoes NP

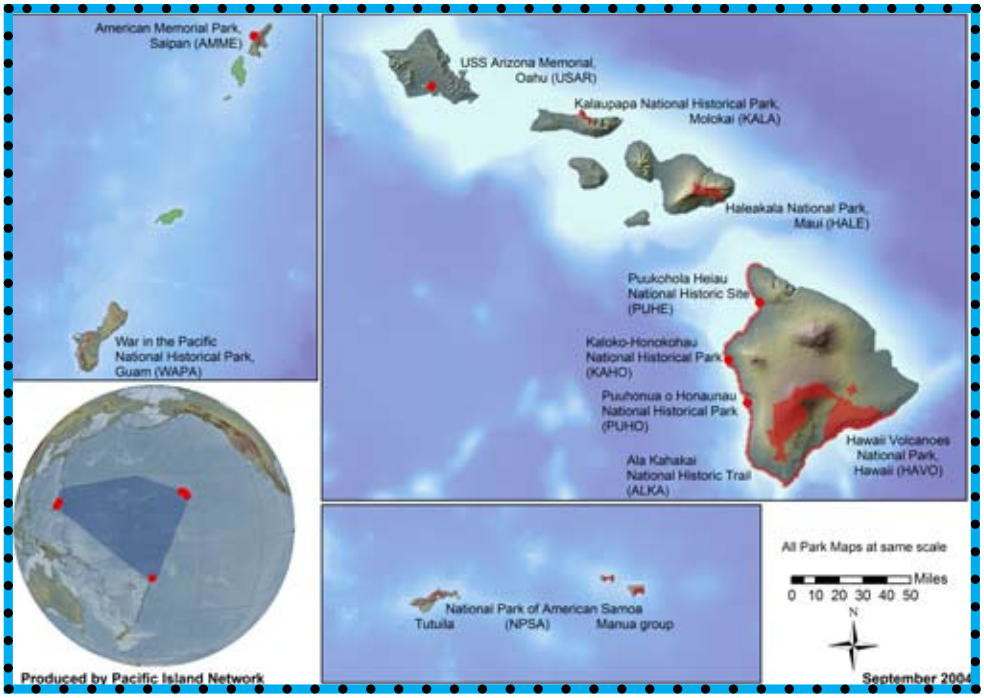
This article falls on the heels of a very successful zone meeting hosted by the Pacific West Regional Office in Honolulu 11/28-29, 2006. Regional Director Jon Jarvis convened the gathering to explore the implications of climate change on NPS management policies and practices to improve our understanding of the physical and ecological effects of climate change on park resources. There are obvious examples of change within our own system, and our parks are the yardsticks by which resource and habitat loss will be measured.


Moon over Mauna Loa

Yet thoughtful discussions were also held about climate change adaptation now being viewed both nationally and internationally as a key element in an integrated program of risk reduction. The human health and hydrological impacts, as well as social implications of adaptation, presented a twist on an already compelling topic, as access to fresh water, protection of public health and community infrastructure, public safety and protection of agriculture would all be impacted. It was clear to me that we were going to have to find a way to build climate information into our hazard mitigation plans, and begin to start using climate information to manage risks and support practical decision-making at the park level. At the same time, we will be conveying optimism and leadership to the public.


Shoreline at Hawai'i Volcanoes National Park

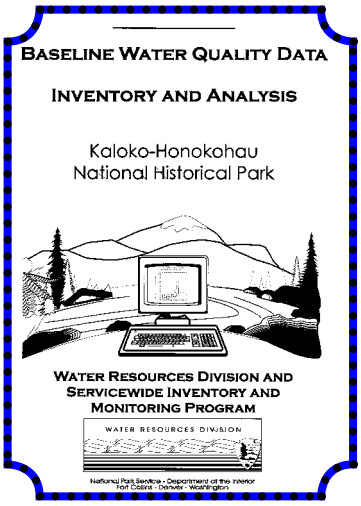
Natural disasters are not new to island ecosystems, and at HAVO we have long discussed the need to integrate them into our risk management activities. I&M, as well as all of our park partners, needs to be a part of the discussion as we identify, interpret, and educate the public to the many stressors we will come to know.



Map of the 11 Pacific Island Network park units.

Inventories – Water Quality Reporting

The I&M program has identified core inventory information that is needed to effectively address park planning and management needs. This includes data on water quality, water body location, and classification. Making these data available for every park with significant natural resources is a cooperative effort of the NPS Water Resources Division (WRD), the I&M Program, and the NPS Baseline Water Quality Data Inventory and Analysis Project. Reports are available online at http://www.nature.nps.gov/water/horizon.cfm.



The inventories include water quality use classifications based upon the Clean Water Act and several basic water quality parameters for "key" water bodies as determined on the basis of size, uniqueness, and threats. Parameters may include alkalinity, pH, conductivity, dissolved oxygen, rapid bio-assessment baseline (EPA/state protocols, involving fish and macro invertebrates), temperature, and flow. Other parameters, as determined on a case-by-case basis, may include the presence of toxic elements, clarity/turbidity, nitrate/nitrogen, phosphate/phosphorous, chlorophyll, sulfates, and bacteria.

Reports for KALA, HALE, PUHE, KAHO, PUHO and HAVO are completed. Data collection for AMME, WAPA, and NPSA has occurred and reports for these parks are expected in Fiscal Year 2007. Summaries on water quality, and water body location and classification can also be found in the PACN monitoring plan and the appended water quality report (see PACN website).

Data Management

Early detection of invasive plant species is one of the 14 Vital Signs for which PACN monitoring protocols are being developed. This protocol will describe a partnership strategy for short- and long-term monitoring to detect invasive plant species external to national park boundaries before they become a threat to the natural resources in 10 PACN parks (AMME, WAPA, NPSA, KALA, HALE, ALKA, PUHE, KAHO, PUHO, HAVO). The protocol will include a list of target species for each island and provide standard operating procedures for early detection surveys. The monitoring efforts of this protocol will focus on plant distribution centers or PDCs (e.g., nurseries, botanical gardens) and corridors (e.g., roads and trails) that constitute major pathways for the spread of invasive plant species.

Relational databases developed by the PACN data management staff will facilitate data entry for the early detection of invasive plants protocol as well as data quality control procedures and data analysis needs. The data produced from each type of survey (PDC and corridors) will be entered into separate databases. The PDC database will include information on all nurseries surveyed, date of survey, and the target species found. The corridor database will include roads surveyed, date of survey, and target species found with corresponding GPS points. Data can then be linked to ArcGIS software to produce a distribution map of invasive species detected during these protocol surveys. These distribution maps, along with tabular output from the PDC and corridor databases, will be shared with partner organizations for invasive plant species analysis and reporting.

The I&M program will be working closely with partner organizations such as the island Invasive Species Committees in the collection and sharing of data. The protocol databases will assist resource managers in evaluating how the presence of target species at PDCs and along corridors is changing over time.

Hot Topic

Earthquake damage in West Hawaii Parks from the October 15 quakes, magnitudes 6.7 and 6.0

KAHO: There is nearly a million dollars in damage estimates to the historical park and its resources, including a section of the Ala Kahakai National Historic Trail. Some natural and historical sites with substantial damage include: an anchialine pond, a burial site, the papa holua (stone slide), stone fencing and corrals.

PUHE: Pu'ukoholā Heiau sustained heavy damage to the northeast and north walls (3/4 collapsed, blocking the entrance into the heiau). Other walls also had varying levels of damage, as did the lesser known Mailekini Heiau.

Structural damages also reached John Young's house site where some braces collapsed along with parts of the house's rock walls. The maintenance building, library, offices, and kitchen all sustained some ceiling damage. On a brighter note, the new visitor's center weathered the quake well and remains free of serious damage.

Top: An invasive morning glory vine (*Ipomoea Sp.*) engulfs the landscape at AMME.

Right: invasive Kāhili ginger (*Hedychium gardneria-num*) at HAVO.

Vital Signs – Landbirds

PACN parks harbor landbird communities that not only are representative of each island, but in many cases are of great importance to the conservation of the birds themselves. That is, PACN parks harbor core populations of endemic landbirds, many of them threatened or endangered. Although it is important to monitor changes in alien landbirds, I&M focuses on the native species as these are of the greatest conservation concern.

There is an extensive legacy of surveying terrestrial birds, collectively known as "landbirds," in Hawaii, and the South and West Pacific. All of these surveys use distance-sampling methods (variable circular point [VCP] count), a sampling technique that was developed in Hawaii.

The VCP, or point transect, method is extremely useful for sampling areas with difficult and dangerous topography and in dense vegetation. The observer records the distance from a station center-point to all birds heard and seen, and then proceeds to the next station along the transect. The importance of recording distance data is that they can be used to first calculate bird population densities and then population size.

I&M has proposed that the Landbirds Monitoring Vital Sign be implemented in HALE, HAVO, and NPSA. It would be challenging to create a landbirds monitoring program for the small PACN parks because the parks are not large enough to hold substantial bird populations. However, landbirds surveys by national and local agencies are conducted in AMME, KALA, and WAPA as part of surveys with broader coverage outside the parks.

West Hawai'i Island parks (ALKA, KAHO, PUHE, and PUHO) and the Arizona Memorial (USAR) were not included in the Landbirds monitoring protocol because these parks are small, and they are situated outside most native species' ranges. Likewise, I&M did not allocate sampling in the Ofu unit of NPSA. This is primarily a marine park unit with only a fringing terrestrial component.

The PACN has taken the first steps toward developing a coordinated monitoring scheme with the Landbirds monitoring protocol. Long-term landbird monitoring in Hawaii is conducted by federal and local agencies. However, the myriad efforts of multiple agencies lead to challenges in understanding patterns at the island-wide and regional scales. The next step is to integrate the PACN Landbirds protocol into a broad-scale, unified bird monitoring scheme. Integrating Landbirds protocol sampling with surveys conducted by other agencies will provide information necessary to address species' range contractions and expansions, and trends in species populations overall.

Notes from the Field

War in the Pacific National Historic Park (WAPA) on Guam is known for its memorials commemorating the campaigns of WWII; however, it also contains the only remnants of limestone forest within the National Park Service. These unique vegetation assemblages are restricted to ancient uplifted coral reef systems surrounded by a mosaic of more recent volcanic substrates. Despite Guam's reputation as a "Petri dish" for invasive species where typical biotic interactions involve one invasive fighting another, members of the PACN vegetation protocol team (Jim Jacobi - USGS, Rhonda Loh - NPS, Joan Yoshioka - CESU, and myself - CESU) were encouraged by the relative intactness of portions of these limestone forests on Guam during our visit in September 2006.

Alison (left) and Joan Yoshioka botanizing in the field at WAPA.

We traveled to Guam and Saipan to discuss park specific vegetation monitoring needs with staff and conduct reconnaissance for focal terrestrial vegetation community and invasive species monitoring. Dwayne Minton, former resource manager at WAPA and AMME, identified limestone forests as a high terrestrial monitoring priority. The long term persistence of these forests on Guam appears to be threatened by invasive plants, animals, and wildfires. Even natural disturbances such as typhoons are threats to long term forest integrity because they create opportunities for faster growing nonnative species such as vines. Four of the seven discontinuous WAPA units contain remnants of limestone forest. We explored two units (Mt. Alifan and Fonte Plateau) and were impressed by the dominance of native species within these communities, but were not terribly excited about the abundance of mosquitoes.

In order to gain a better perspective on the status of the WAPA limestone forests, we investigated forests along the road on the northern portion of the island. However, our walking tour was cut short by the arrival of the military police which was not terribly surprising considering that we were adjacent to the air force base. Jim and Rhonda quickly explained to the MP's that we were innocent botanists admiring the giant native yoga trees (*Elaeocarpus joga*) along the roadside. Immediately, they relaxed and bombarded us with questions about various interesting plants they had observed around the island and recommended sites for us to visit.

We were fortunate to have the opportunity to discuss the status of Guam's biota and invasion threats with park staff, territorial biologists, and an ecologist from the University of Guam. As a result of these discussions the vegetation monitoring protocols will be more useful to WAPA, and will also provide additional data on the status of limestone forest communities on Guam.

- Alison Ainsworth

Featured Staff

ALLISON SNYDER (NPS)
KELLY KOZAR (RCUH)

Allison has been working for the I&M Program since 2003. She completed her master's degree with the Ecological Restoration Institute at Northern Arizona University. There, she used satellite imagery to study forest change due to wildfire, as well as analyzed changes in forest structure and composition resulting from a century of fire exclusion. Allison was first employed as the Ecological Monitoring Spatial Data Specialist, and currently serves as the Database Programmer where she assists in the implementation of the PACN data management strategy.

Kelly has worked in Hawaii for over eight years on a variety of projects. She has studied forest bird demography in the wet forest of Hakalau Wildlife Refuge, the endangered Palila in the dry forest of Mauna Kea, the endangered Laysan duck on the Northwestern Hawaiian Island of Laysan, and the effects of avian malaria on endemic forest birds. She started her career with I&M as inventory coordinator and is now assisting with the creation of databases for a variety of Vital Sign protocols.

Program Update

Monitoring Plan: After several years of hard work by I&M staffers, cooperators, and many partners the PACN Monitoring Plan was completed and submitted to WASO at the end of September. The Monitoring Plan is available at: http://www1.nature.nps.gov/im/units/pacn/monitoring/plan.cfm.

Vital Signs: The Landbirds and Benthic marine protocols are in review, and the Water quality protocol is scheduled for review submission in December. The plant protocols team has been conducting site visits to several parks including NPSA, WAPA, AMME, West Hawai'i parks, and others to gather logistics information for protocols development. Several other protocols are also at various stages of development.

A statistical workshop for Vital Signs monitoring protocol development with contracted statistician David Schneider took place in October at HAVO. The workshop not only addressed many statistical challenges for each protocol, but it also facilitated dialogue between protocol teams for co-location and resource sharing.

The new Technical Committee and the Board of Directors have tasked the I&M program to reduce its overall workload. This task will require close attention by I&M staff and protocol Principal Investigators to resolve.

Outreach: In this quater, staff presented posters at the CIRMOUNT climate conference in Oregon, and at the PacGeo conference in Honolulu.

I&M staff and a cooperator participated in the Hawaii County Fair in conjunction with HAVO's information booth. I&M also spearheaded and led a presentation at HAVO's visitor center for GIS day, and participated in KAHO's children's cultural festival with a display and activity involving wayfinding and seabirds.

Staffing: Unfortunately December marks the final farewell of Raychelle Daniel to the I&M program. She has been a CESU/PCSU cooperator with I&M for several years, and has been instrumental in the success of the program. Most notably, she devoted much time and a herculean effort to the development of the Benthic marine protocol. On the NPS side, I&M also lost the indispensable services of our Administrative Technician, Kim Leyson. We wish him well in retirement.

Data news: The Early detection of invasive plants database is being utilized by the Big Island Invasive Species Committee.

Calendar • Oct. - Dec. , 2006

Sept. 28 = Monitoring Plan electronically submitted to WASO
Oct. = AARWP submitted to PWR for Initial review
Oct. = Statistics meetings for Vital Signs protocol development with D. Schneider at HAVO
Oct. 13 = I&M Monitoring plan BBQ at HAVO
Oct. = Benthic Marine protocol submitted to WASO for review
Nov. 15 = GIS Day at HAVO
Nov. 16&17 = I&M participates at KAHO keiki cultural festival
Nov. 27 = Technical Committee meeting
Nov. 30 = Board of Directors meeting
Dec. 7 = I&M staff attend Pearl Harbor Day commemoration at USAR
Dec. 14 = I&M holiday party
Dec. 22 = The Water quality protocol submitted to WASO for review

Games Corner

What in the world are they doing?

Field work has many shapes and forms. Try to guess what these scientists are looking for.

Answers are below:

ANSWERS:

1-Groundwater sampling at AMME
2-Measuring of biomass in soil related to erosion at WAPA
3-Vascular plant inventory at KALA
4-Sedimentation levels on corals at WAPA
5-Vascular plant inventory at KALA
6-Measuring acoustic seabird activity at NPSA

The Sea Turtle - Honu, Laggan, or Laumei

Description: Sea turtles are air-breathing reptiles, well-adapted to a warm ocean water existence. They have a streamlined body that moves easily in the water, propelled by strong front flippers with back flippers acting as rudders. There are seven species of sea turtles world-wide. The two species most commonly found foraging or nesting in or near most Pacific Island Network parks are green turtles (*Chelonia mydas*) and hawksbill turtles (*Eretmochelys imbricata*). Each species has distinct features and habitats. The adult green sea turtle (the larger of the two species) weighs 300-400 pounds and has a carapace (a protective shell formed by bony plates) length of 3.5-4 feet with varying shades of black, gray, green, brown, and yellow. This species is primarily vegetarian and eats sea grass and algae. Its habitat is shallow coastal waters, bays, and protected shores. The hawksbill turtle is significantly smaller and weighs 100-150 pounds, with a carapace length of 2.5-3 feet with brown, orange, or yellow coloration. It feeds primarily on marine invertebrates (sponges, anemones, squid, shrimp) and can be found near coastal reefs, rocky areas, estuaries and lagoons. Both species have strong site fidelity. After mating at sea they return to the same stretch of sandy beach to lay eggs. After about 2 months, hatchlings crawl together towards the sea.

Cultural Significance: Sea turtles have important roles in the environment and culture of the Pacific Islands. They are featured in mythology, petroglyphs, and as ‘aumakua (personal family guardians). Today, their significance is enduring world-wide. The year 2006 was designated “Year of the Turtle” to raise awareness about the role and importance of marine turtles, see: http://www.ioseaturtles.org/yot2006/bg_information.php.

Inventories and Monitoring: The National Park of American Samoa does not officially conduct sea turtle inventories. However, they assist by reporting any turtle sightings to the Department of Marine and Wildlife (DMWR). Since the 1990’s satellite tagging has been used to monitor migrating sea turtles in the Pacific West Region. Kalaupapa NHP has recorded satellite tracking of hawksbills nesting on Maui and traveling to foraging grounds near Molaka‘i. Sea turtles within Pu‘uhonua o Hōnaunau NHP are routinely tagged and monitored by National Oceanic & Atmosperic Administration (NOAA), and monitoring of green sea turtles has been conducted by staff at Kaloko-Honokōhau NHP (KAHO) and the National Marine Fisheries Service (NMFS). NMFS is additionally supporting turtle nesting beach monitoring on Saipan, Guam, and American Samoa (AS). Additionally, DMWR has been conducting tagging studies in AS. For the American Samoa “Year of the Sea Turtle” campaign, a nesting hawksbill was tagged and monitored. Hawksbill turtles are also monitored at Hawai‘i Volcanoes NP.

Top and top left: *Green sea turle at Pu‘ukoholā Heiau National Historic Site.*

Bottom: *Hawksbill turtle hatchling at the National Park of American Samoa.*

Photo by M. Hart

Data: A seaturtle database is used to record data collected at KAHO. Another database, the Turtle Research Database System (TREDS), developed through a collaborative effort by the Secretariat of the Pacific Regional Environment Programme, Western Pacific Regional Fishery Management Council, Secretariat of the Pacific Community, NOAA Fisheries, Queensland Government Environmental Protection Agency, South-East Asia Fisheries Development Centre, and the Marine Research Foundation is currently in trial studies within American Samoa and other Pacific Islands. The database is designed to consolidate data regarding tag deployment, nesting beach/foraging ground monitoring, and hatchlings.

Threats: All species of turtles are threatened with extinction. Some common threats include *fibropapilloma* tumors, poaching, nesting threats such as habitat loss, and marine environment threats such as entanglement from marine debris and fishing gear. Loss of nesting habitat is a world-wide problem since sea turtles will return to the same beach year after year. *Fibropapilloma* disease is caused by a virus that produces fibrous growths on the eyes, mouths, necks, and flippers.

Conservation and Management: Green sea turtles are currently listed within the Pacific Region as “threatened” and the hawksbill as “endangered” under the U.S. Endangered Species Act of 1973. Sea turtles are protected under federal and state/territorial laws in the Pacific Island Network. Studies indicate that the overall Pacific sea turtle population is declining. Sea turtle conservation is critical in order to prevent decreasing populations. Promoting public awareness regarding protecting them and the importance of preserving their habitat will provide safe havens for nesting and food sources. Sea turtles evolved approximately 180 million years ago and are an important aspect of a healthy marine ecosystem. Let's hope they survive another 180 million years.

For more information:

http://www.nmfs.noaa.gov/pr/species/turtles/
http://www.pifsc.noaa.gov/psd/mtrp/
http://www.fws.gov/pacificislands/wesa/endspindex.html#Pacific
http://www.pifsc.noaa.gov/library/greenseaturtle.php
http://www.turtles.org/overview.htm
http://www.ioseaturtles.org/yot2006/factsheet.php

Climate Change in the Mid-Pacific

Background & Description: Global climate change is a natural phenomenon; that is, there are natural long-term climate cycles that lead to changes in climate. However, human-induced global climate change is expected to include much more rapid rates of change in weather or climate patterns than have been experienced for millennia. Marine and coastal, and in particular, small island ecosystems, are considered to be especially vulnerable to rapid climate change. This is because landmass is very limited and that other stressors, such as changes in land use (increased urbanization) and introductions of alien species, already put these ecosystems at risk.

Climate variability and change that will affect the PACN region includes increased sea surface temperatures and UV radiation which will affect coral reefs and other marine resources. In addition, the effects of sea level rise on shoreline and coastal communities, and the spread of avian malaria and other vector borne diseases will intensify due to changes in temperature and rainfall patterns. Changes to the height and frequency of the trade wind inversion are also predicted, and could lead to changes in rainfall patterns and cloud immersion time for wet forests. Moreover, the effects of extreme events such as prolonged, El Nino Southern Oscillation (ENSO)-related droughts and a possible increase in frequency and intensity of tropical cyclones and associated flooding are concerning.

Sea Level: There is little doubt in the scientific community that global sea levels are increasing and will continue to rise due to human-induced climate change. This is due to increased temperatures which lead to melting of sea ice and glaciers, as well as thermal expansion of ocean water. Sea levels are also influenced by several other factors. The actual water level that occurs at a coastal site is determined by the seasonal sea level, the astronomical tides, and the shorter-period responses to weather forcing, especially winter storms.

Generally, comparisons of sea levels are made for mean levels midway between mean high and low water level. Because of varying factors, sea level trends in the PACN region are not uniform and the contribution of climate change to increased sea levels is difficult to determine. Low islands and atolls are considered to be especially at risk. In addition, many islands, including the Hawaiian Islands, are sinking (and sea level is rising). In some cases this is due to increased weight as active volcanoes spew out lava and add more mass.

Data and information about sea levels can be found at the University of Hawaii Sea Level Center (http://ilikai.soest.hawaii.edu/uhslc) and on several National Oceanic and Atmospheric Administration websites. In addition, the Pacific ENSO Applications Center provides short term (up to a year) forecasts for sea levels in the Pacific region that are immensely valuable for anyone involved in civil defense or natural resources management (http://www.soest.hawaii.edu/MET/Enso/peu/2006_4th/Sea_Level.htm).

Temperature and Precipitation: Climate change predictions are based on models with spatial resolutions too low to predict changes on the tiny specks of land in the Pacific Ocean. Thus, there are no predictions indicating how temperature and precipitation will change for individual Pacific islands. However, predictions for the Pacific region as a whole include temperature increases. Rainfall is predicted to increase as well, but not uniformly throughout the year. Rainy seasons are predicted to experience higher rainfall while dry seasons will be dryer than in the past. Data (below) provided by Dr. Tom Giambelluca (University of Hawaii) indicate that a warming trend may already be taking place in Hawaii.

For more information contact:
Karin_Schlappa@contractor.nps.gov

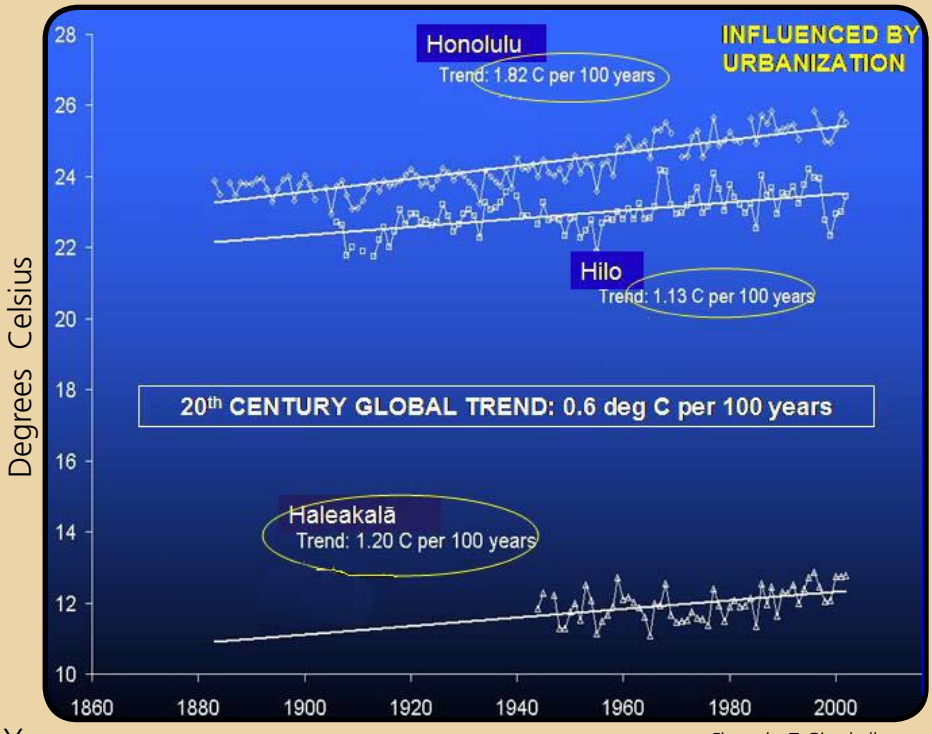


Figure by T. Giambelluca

Air temperature data for Honolulu, Hilo, and Haleakalā weather stations. Lines indicate the warming trend. While Honolulu data reflect the urban heat island effect, Haleakalā data show that even in remote areas temperatures are increasing. For Haleakalā the 100-year warming trend was extrapolated from available data between 1942 and 2003.

Hawai'i Volcanoes National Park — Hawai'i

Hawai'i National Park was established on August 1, 1916 by President Woodrow Wilson. At that time, the 13th National Park included both the summits of Kīlauea and Mauna Loa as well as the summit of Haleakalā on Maui. Together, these three areas were named Hawai'i National Park. It wasn't until 1961 that these protected lands were separated into what we now know as Hawai'i Volcanoes National Park (HAVO) and Haleakalā National Park. In July 2003, 116,000 acres were added to HAVO through the acquisition of the Kahuku Ranch. HAVO now totals 333,000 acres of rich natural, cultural, and geological landscapes.

Cultural History: Hawai'i Volcanoes National Park is a reservoir of cultural history. Stretching from its beautiful sandy shores to its mountainous terrain, this park is home to 333 archeological sites consisting of 2,169 features as well as the vibrant living culture attached to them. Our significant cultural resources also include the Kūpuna (cultural advisors) who, through consultation, assist and educate us about these resources. Hawaiians believe that Hawai'i Volcanoes National Park, in its entirety, is a powerful source of mana (guiding spiritual power) and is wahi kapu (sacred land).

Natural History: As one explores this expansive park, they are bound to experience a natural resource full of life and beauty. Some of these wonders are not as easily experienced as others such as rare, endangered, and threatened native endemic flora and fauna. These unique species, whether it is the Hawaiian petrel ('ua'u), *Pterodroma sandwichensis*, that nest only on the high slopes of Mauna Loa or the 'ohai (*Sesbania tomentosa*) found along our coastal shores, are prized jewels the Park Service works hard to protect.

Inventory and Monitoring Highlights: The I&M program played a role in several inventories at HAVO in an effort to document at least 90% of vascular plant and faunal species present. These inventories provide information crucial to the development of monitoring protocols. Some noteworthy plant inventories were conducted at the Kahuku Ranch and a remote volcanic trench in the Ola'a rainforest, with emphasis placed on developing plant checklists, mapping distributions of rare plants and alien weeds, and describing rare plant communities.

Terrestrial fauna inventories included both native and non-native birds, mammals, invertebrates, and herpetofauna (reptiles and amphibians). A seabird inventory used marine radar to identify seabird flight corridors within HAVO. A second inventory incorporated ground and auditory searches for seabird colonies on Mauna Loa. The relative abundance of shore and water birds was estimated in a park shoreline inventory. Also, forest birds were inventoried to generate estimates of abundance and occurrence. Three endangered forest birds were detected within the newly acquired Kahuku unit, thereby adding to HAVO's species list.

An inventory of the Hawaiian hoary bat, the only native terrestrial mammal in Hawaii, was conducted to assess distribution in the park and adjacent areas. Other mammal inventories such as pig activity was studied to determine the effects of population density on native vegetation. Rodents were surveyed to determine species abundance and distribution along an elevational gradient. Some invertebrates that were inventoried include native *Drosophila* pomace flies, *Megalagrion* damselflies, and *Omiodes* moths, as well as invasive yellowjackets, ants, and leafhoppers. Finally, although this list is not exhaustive, anchialine pools and associated communities were also inventoried.

Due to the sheer size, and ecological and historical importance of HAVO within the National Park Service, most I&M Vital Signs monitoring protocols will be implemented in the park. From monitoring protocols regarding invasive plants, to forest birds, to climate, cave communities, and more, HAVO is a key Pacific Island Network park for implementing I&M's monitoring program.

Current Issues in Management: To better manage natural resources at HAVO there is a need for more information on the health and trends of ecosystems found within the park. Landscapes and ecosystems change rapidly due to volcanic activity, alien species invasions, and the manipulative management actions needed to restore native ecosystems. Management priorities at HAVO include the identification, control, and removal of invasive species inside the park as well as those species that are threatening to invade and alter park ecosystems. Likewise, the loss of biodiversity is a major concern. Park management is working to stabilize selected Threatened and Endangered species, and Species of Concern, through species reintroduction and habitat restoration programs. Other management goals include the maintenance of soundscapes, lightscapes, and wilderness, as well as control of disturbance sources such as fire.

Come visit us:

HAVO is located 28 miles west of Hilo on Hawai'i Island. On the Web at: http://www.nps.gov/havo/

Photos from top to bottom: *Feral sheep in Kahuku, ocean-entry lava flows, ripe 'ōhelo berries, and an 'ua'u (Hawaiian petrel) preparing for take-off.*